2015-DSE
ICT
PAPER 2D

HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY

HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2015

INFORMATION AND COMMUNICATION TECHNOLOGY

PAPER 2D

Software Development

Question-Answer Book

11.15 am – 12.45 pm (1 hour 30 minutes)
This paper must be answered in English

Please stick the barcode label here.

Candidate Number									
Programming Language Used (Please tick one)	Pascal ☐	C ☐	Visual Basic ☐	Java ☐					

INSTRUCTIONS

(1) After the announcement of the start of the examination, you should first write your Candidate Number in the space provided on Page 1 and stick barcode labels in the spaces provided on Pages 1, 3, 5 and 7.

(2) Tick the appropriate box for the programming language used. **No marks will be awarded if you tick either more than one box or no boxes.**

(3) **ANSWER ALL QUESTIONS.** Write your answers in the spaces provided in this Question-Answer book. Do not write in the margins. Answers written in the margins will not be marked.

(4) Supplementary answer sheets will be supplied on request. Write your candidate number, mark the question number box and stick a barcode label on each sheet, and fasten them with string **INSIDE** this book.

(5) No extra time will be given to candidates for sticking on the barcode labels or filling in the question number boxes after the 'Time is up' announcement.

Answer all questions.

1. `Func(a, b)` is a function with two positive integer inputs `a` and `b`, where `a` ≥ `b`. It returns the integral part of `(a÷b)`. For example,

`Func(6,2)` returns `3` and `Func(7,3)` returns `2`.

(a) (i) What will `Func(14,3)` return? _____

(ii) `mod(a, b)` is a function that returns the remainder of `(a÷b)`. Complete the pseudocode of `Func(a, b)` below.

```
Func(a, b)
    c ← mod(a, b)
    return ( [          ] ) ÷ b
```

(3 marks)

The following algorithm ALG1 processes a Boolean array `B` with indices from `1` to `n`.

```
ALG1
Step 1:  for k from 1 to n do Step 2
Step 2:      B[k] ← True
Step 3:  B[1] ← False
Step 4:  for i from 1 to n do Steps 5 to 7
Step 5:      if B[i] = True then do Steps 6 to 7
Step 6:          for j from 2 to Func(n, i)
Step 7:              B[i × j] ← False
```

(b) Suppose `n = 10`. Dry run ALG1. Use 'F' and 'T' to denote '`False`' and '`True`' respectively in the following tables.

(i) Fill in the content of `B` after the first pass and second pass of the loop in Step 4.

After first pass

B[1]	B[2]	B[3]	B[4]	B[5]	B[6]	B[7]	B[8]	B[9]	B[10]

After second pass

B[1]	B[2]	B[3]	B[4]	B[5]	B[6]	B[7]	B[8]	B[9]	B[10]

(ii) Fill in the final content of `B`.

B[1]	B[2]	B[3]	B[4]	B[5]	B[6]	B[7]	B[8]	B[9]	B[10]

Answers written in the margins will not be marked.

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(iii) How many times will the statement in Step 7 be executed? _____

(iv) What is the purpose of ALG1?

_____

(6 marks)

(c) (i) It is suggested that Step 4 should be changed to

'for `i` from `2` to `n` do Steps 5 to 7'

Will this change affect the final content of B? Justify your answer.

_____

_____

_____

(ii) It is suggested that changing Step 4 to

'for `i` from `1` to `Func(n,2)` do Steps 5 to 7'

can improve the algorithm. Do you agree? Justify your answer.

_____

_____

_____

(iii) ALG1 will be executed many times. Should it be implemented in a compiled language or an interpreted language? Explain briefly.

_____

_____

_____

(6 marks)

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2. John is a project manager. He develops a vehicle repair system. The development work involves four major tasks. The duration and dependencies of the tasks are shown below:

	Duration (week)	Task(s) that it depends on
Task 1	3	Task 2
Task 2	4	-
Task 3	3	Task 1 and Task 4
Task 4	6	-
Task 5	3	Task 4

(a) (i) Complete the Gantt chart of the project below.

Task \ Week number	1	2	3	4	5	6	7	8	9	10	11	12
Task 1												
Task 2												
Task 3												
Task 4												
Task 5												

(ii) Suppose that John spends more money to reduce the duration of Task 1, Task 2 and Task 3 by 1 week each. What is the duration of the new critical path of the project?

(5 marks)

(b) (i) Task 2 is part of the requirements analysis stage. Give **two** common activities that John can do to collect the requirements when doing Task 2.

(ii) Task 1 is part of the implementation stage. After completing Task 1, what documents will be prepared? Give one example and explain its use briefly.

(4 marks)

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(c) John selects a programming language for the system development based on the following criteria. Briefly describe the criteria and their benefits for system development.

(i) Modularity _____

(ii) Portability _____

(iii) Utility libraries and development tools _____

(6 marks)

(d) When compiling the program code of the system, a linker is used. What is the purpose of the linker?

(2 marks)

Answers written in the margins will not be marked.

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3. Tony is developing a yearly school calendar system. There are events, `E1`, `E2`, etc. marked in the calendar using 1-52 and 1-7 to denote the weeks and the days respectively, as shown in the example below. Assume that there is only one event at most each day.

Week \ Day	1	2	3	4	5	6	7
1	E1				E3		
2							
3		E4				E2	
4							
⋮							⋮
52				E88			

`(x,y)` represents Day `y` in Week `x` in the calendar. Tony wants to use an array `M` so that `M[x,y]` stores the name of the event on `(x,y)`. `M[x,y]` stores `0` if there is no event on that day.

(a) Referring to the example above, complete the following table to illustrate the content of `M`.

Array element	Content
`M[1,5]`	E3
`M[3,2]`	
`M[3,3]`	

(2 marks)

Tony decides to use three global arrays `name`, `x` and `y` to store the information on the events in the calendar in chronological order, as shown in the example below.

i	name[i]
1	E1
2	E3
3	E4
4	E2

i	x[i]
1	1
2	1
3	3
4	3

i	y[i]
1	1
2	5
3	2
4	6

Answers written in the margins will not be marked.

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(b) Tony writes a subprogram `Lname(p,q)` that returns the name of the event on Day `q` in Week `p`. It returns `0` if there is no event on that day.

(i) Suppose that `n` stores the total number of events. Complete the pseudocode of `Lname` below.

```
Lname(p,q)
    event ← [                              ]
    for i from 1 to n do
        if (x[i] = p) and (y[i] = q) do                    (the third line)
            event ← [                              ]
    return event
```

(ii) Suppose `n = 4`. When `Lname(2,3)` is called, how many times will the statement on the third line be executed?

_____

(iii) Compared with `M` in (a), give one advantage and one disadvantage of using the three arrays to store information on the events.

Advantage: _____

_____

Disadvantage: _____

_____

(5 marks)

Tony writes a subprogram `order(x1,y1,x2,y2)` that returns `TRUE` only when `(x1,y1)` is earlier than `(x2,y2)` in the calendar; otherwise, it returns `FALSE`.

(c) Complete the following pseudocode of `order`.

```
order(x1, y1, x2, y2)
    if (x1<x2) return TRUE
        else if (x1>x2) return _____
            else if (y1<y2) return TRUE
                else return _____
```

(2 marks)

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Tony writes another subprogram `shift(a,b)` that shifts all the entries with indices between `a` and `b` backward by one position in each of the three arrays. For example, `name[b+1]` stores the value in `name[b]`, `name[b]` stores the value in `name[b-1]`, and so on. Finally, `name[a+1]` stores the value in `name[a]`; the corresponding entries in `x` and `y` will shift too. Assume that there are `n` events in the calendar.

i	name[i]
1	E1
2	E3
⋮	
n	E88

i	x[i]
1	1
2	1
⋮	
n	52

i	y[i]
1	1
2	5
⋮	
n	4

Tony wants to store a new event in the three arrays in chronological order where the event name and its date are stored in `NewName` and `(Newx, Newy)` respectively. There are two subprograms `order` and `shift` available:

Pascal version	`Function order(x1, y1, x2, y2 : integer) : boolean` `Procedure shift(a, b : integer)`
C and Java version	`int order(int x1, int y1, int x2, int y2)` `void shift(int a, int b)`

Visual Basic version	`Function order(x1 As Integer, y1 As Integer,`
	`x2 As Integer, y2 As Integer) As Boolean`
	`Sub shift(a As Integer, b As Integer)`

(d) Write a subprogram `InsertEvent` in Pascal, C, Visual Basic or Java that stores the information on the new event in the calendar in chronological order using the binary search technique.

(5 marks)

Answers written in the margins will not be marked.

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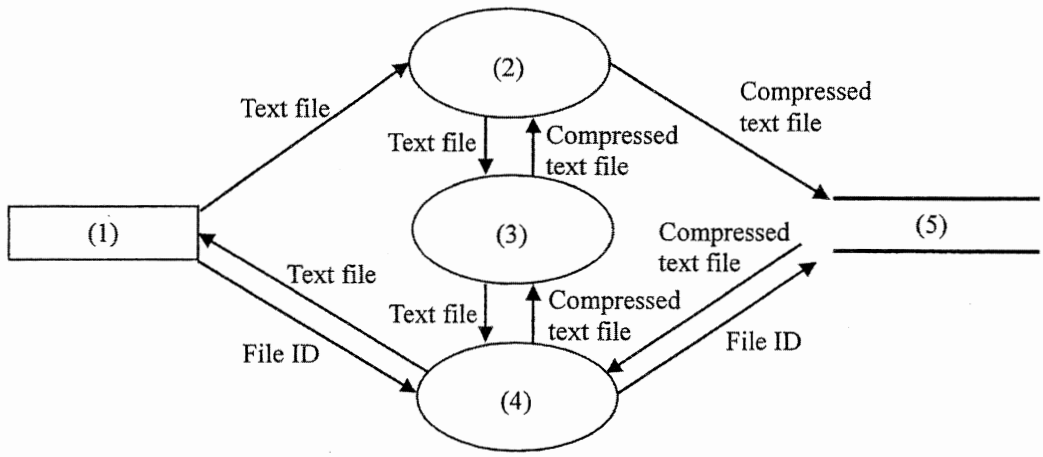
4. Mary wants to develop an online storage system so that customers can store text files in centralised servers and retrieve them later. In order to minimise the demands on storage capacity, all files will be compressed before storage.

(a) The flow of data in the online storage system is shown below:



Match the following items:

A. File storage module
B. File database
C. File retrieval module
D. Compression and decompression module
E. File ID verification module
F. Customers

(1) _____

(2) _____

(3) _____

(4) _____

(5) _____

(5 marks)

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There are many words in the text files. Mary considers using 16-bit fixed-length binary sequences or variable-length binary sequences to encode the words. Each variable-length binary sequence has only one '1'. An example is shown below:

Word	Fixed-length binary sequence	Variable-length binary sequence
pen	0000000000000000	1
a	0000000000000001	01
man	0000000000000010	001
has	0000000000000011	0001
Peter	0000000000000100	00001
is	0000000000000101	000001
and	0000000000000110	0000001

(b) (i) Give an advantage of using fixed-length binary sequences.

_____

_____

(ii) Give an advantage of using variable-length binary sequences.

_____

_____

(2 marks)

Mary decides to use variable-length binary sequences.

(c) According to the table above, 'Peter has a pen' will be encoded as

'000010001011'

(i) Encode 'Peter is a man'.

_____

(ii) Decode '010010000001011'.

_____

(2 marks)

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(d) Mary writes a function `DEC(st)` that returns the words in a look-up table for variable-length binary sequences, as shown in the example below.

Variable-length binary sequence	Word
1	pen
01	a
001	man
0001	has
00001	Peter
000001	is
0000001	and
⋮	⋮

Assume that a character array `B` with length `n` stores the encoded binary sequences for a text file. Write a pseudocode to decode the sequences and display the text with the use of `DEC`.

(5 marks)

END OF PAPER

Answers written in the margins will not be marked.

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